UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. Larry Lawson, Director
Division of Water Program Coordination
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Lawson:

The Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Loads (TMDLs) report for the primary contact (bacteria) and aquatic life use impairments on Long Glade Run and Mossy Creek. The TMDLs were submitted to EPA for review in April 2004. The TMDLs were established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998 Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDLs for the primary contact and aquatic life use impairments satisfy each of these requirements.

Following the approval of the TMDLs, Virginia shall incorporate the TMDLs into the appropriate Water Quality Management Plans pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Thomas Henry at (215) 814-5752.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

**Total Maximum Daily Loads for
the Primary Contact (Bacteriological) and Aquatic Life Use Impairments on
Long Glade Run and Mossy Creek**

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA's) rationale for approving the TMDLs for the primary contact (bacteriological) and aquatic life use impairments on Long Glade Run and Mossy Creek. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The Long Glade Run and Mossy Creek Watersheds are located in Augusta and Rockingham Counties in Northern Virginia. These neighboring watersheds are both in the North River Basin. Both impairments begin at their headwaters and terminate at their confluence with the North River. Both segments are approximately 10 miles long. Both watersheds are small with watershed areas between 10,000 and 11,000 acres. Long Glade Run and Mossy Creek are heavily agricultural watersheds with agricultural lands making up 75 and 71 percent of the watersheds respectively. Forested lands make up between 22 and 25 percent of the watersheds with the remainder consisting of developed lands.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 10.75 miles of Long Glade Run (VAV-B24R) and 9.65 miles of Mossy

Creek on Virginia's 1998 Section 303(d) list as being unable to attain their primary contact use. These segments were listed on the 2002 Section 303(d) list as well. The decision to list these two streams was based on observed violations of the Commonwealth's bacteriological criteria. At the time of the initial listings, the bacteria criteria used fecal coliform as an indicator species and had an instantaneous standard 1,000 colony forming units (cfu) per 100 milliliters (ml) and geometric mean standard of 200 cfu/100ml. Mossy Creek was also listed for failing to attain the aquatic life use based on biological assessments conducted within the watershed.

Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA encouraged the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation was drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth adopted e-coli and enterococci criteria in January 2003. According to the new criteria, streams will be evaluated via the e-coli and enterococci criteria after 12 samples have been collected using these indicator species. Twelve e-coli samples were collected from both Long Glade Run and Mossy Creek.

As Virginia designates all of its waters for primary contact, all waters are required to meet the bacteriological standard for primary contact. Virginia's standard applies to all streams designated as primary contact for all flows. The e-coli criteria requires a geometric mean concentration of 126 cfu/100ml of water with no sample exceeding 235 cfu/100ml of water. Unlike the new fecal coliform criteria, which allows a 10% violation rate, the new e-coli criteria requires the concentration of e-coli to not exceed 235 cfu/100ml of water.

Although the TMDLs and criteria require the 235 cfu/100ml of water concentration limit not be exceeded, waters are not placed on the Section 303(d) list if their violation rate does not exceed 10%. Therefore, Long Glade Run and Mossy Creek may be deemed as attaining their primary contact use prior to the implementation of all of the reductions called for in the respective TMDL. It is necessary to keep this in mind because of the reductions required to attain the instantaneous criteria for e-coli according to the model.

The TMDLs submitted by Virginia are designed to determine the acceptable load of e-coli which can be delivered to the impaired waters, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze the impaired waters because of its dynamic ability to simulate both watershed loading and receiving water

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[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

quality over a wide range of conditions. The model was run to determine the fecal coliform loading to Long Glade Run and Mossy Creek. The loads were then converted to e-coli using a conversion factor established by the Commonwealth.

The TMDLs allocate the application/deposition of fecal coliform to land based and in-stream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform which is reaching the streams from land based sources. Point sources and wastes deposited directly to the streams are treated as direct deposits. Wastes which are deposited directly to the streams do not need a transport mechanism.

Local rainfall and temperature data were needed to develop the model. Weather data provides the rainfall data which drives the simulation. Hourly weather data was obtained from the Dale Enterprise, Lynchburg Airport, and Elkins Airport weather stations.

Stream flow data was available for both waters. Therefore, the simulated stream flow of the model could be compared directly to observed flow data. The data periods in each watershed were small and a severe drought impacted much of the Long Glade Run data. Mossy Creek was not as impacted by the drought since it is fed by four springs. The Mossy Creek model was calibrated to observed flow data from September 1998 to December 1999. During the calibration period the model parameters were adjusted until the simulated data accurately reflected the observed flow data. The model was validated against flow data from January 2000 to September 2002. During validation the model parameters were held constant to insure that the model was accurately reflecting stream processes. As mentioned above, Long Glade Run did not have as much useable data. Therefore, the model was not validated against a separate data set. The model for Long Glade was calibrated to flow data from September of 1999 to July 2000.

After developing the hydrology models, loading parameters were developed for each model to determine the water quality of the streams. The water quality model for Mossy Creek was calibrated to observed data from 1998 to 2002. The Long Glade Run water quality model was developed for the same data period as the hydrology model. Both models removed the impacts from cattle in-stream when the stream flow was below three inches and one inch respectively.

Through the development of these and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the bacteria criteria. According to the models, wildlife reductions were necessary to attain the bacterial standard in Long Glade Run. Bacteria source tracking (BST) data collected in the watershed, indicated that bacteria from wildlife represents a significant portion of the total load,

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[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

which confirmed the model results. Many of Virginia's TMDLs, including the TMDL for Long Glade Run, have called for some reduction in the amount of wildlife contributions to the impacted streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In Phase 1 of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that during Phase 2, it may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated for secondary contact.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted. It should be noted that the reductions necessary to attain a 10 percent violation rate of the standard, which is the threshold for Section 303(d) listing, would require less stringent reductions, reductions from wildlife in-stream would not be required.

The TMDLs were modeled using fecal coliform loading rates as was done in previous TMDL efforts. The fecal coliform concentrations were then converted to e-coli concentrations using a translator equation developed by VADEQ. Significant reductions in the modeled load were required in order for Long Glade Run and Mossy Creek to attain the new e-coli criteria in the model. More stringent reductions were required to meet the instantaneous standard than the geometric mean.

To assess the biological integrity of a stream, Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine status of a stream's benthic macroinvertebrate community.[3]

This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.[4] The state is currently in the

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[3]Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

[4]Ibid 3

process of changing this methodology to a stream condition index (SCI) approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological community of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters. Mossy Creek was assessed as moderately impaired on several assessments.

The RBPII analysis assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. However, it will not inform the biologist as to what is causing the degradation of the benthic community. Additional analysis is required to determine the pollutants which are causing the impairment. TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.[5] A reference watershed approach was used to determine the stressors and numeric endpoints for Mossy Creek. Numeric endpoints represent the water quality goals that are to be achieved through the implementation of the TMDL which will allow the impaired water to attain its designated use. A reference watershed approach is based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphological characteristics with the impaired watershed. The stream conditions and loadings in the reference stream are assumed to be the conditions needed for the impaired stream to attain standards.

Since the state is switching to the SCI for biological assessments, the TMDL modelers evaluated Mossy Creek based on the SCI. Unlike the RBPII analysis, the SCI has a scoring system based on a statistical analysis of a large benthic database.[6] Therefore, the SCI does not evaluate the benthic community on a one to one basis but evaluates the monitored community against the condition of several nonimpaired waters at once. The stream was evaluated as being in better condition using the SCI approach but it was still evaluated as impaired.

Water quality data collected from Mossy Creek were compared to water quality data collected from Upper Opequon Creek. Upper Opequon Creek has a healthy benthic community as determined through an RBPII analysis. The evaluation compared water temperatures, nutrient loads, dissolved oxygen (DO) concentrations, habitat assessments, pH and sediment loads to the numeric criteria and/or the data obtained from Upper Opequon Creek. The analysis concluded that an excessive sediment load was impairing the benthic community of Mossy Creek. This determination was based on the aquatic assemblage observed within Mossy Creek, the habitat

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[5]Ibid 3

[6]MapTech, 2004, General Standard Total Maximum Daily Load Development for Unnamed Tributary to Deep Creek.

assessment of Mossy Creek, and the higher suspended solids concentrations in Mossy Creek compared to the data from Upper Opequon Creek.

The benthic TMDL was developed using the Generalized Watershed Loading Function model (GWLF). The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).[7] GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[8] Calculations are made for sediment based on daily water balance totals that are summed to give monthly values. To equate the reference watershed with the monitored watershed, the reference watershed was increased in size to that of the impaired watershed in the model, the landuses were proportionally increased based on the percent land use distribution. Therefore, the landuse breakdown in the reference watershed remained constant.

Table 1 - Summarizes the Specific Elements of the TMDLs.

Segment	Parameter	TMDL	WLA	LA	MOS
Long Glade Run	E-Coli	2.32E+12(cfu/yr)	5.23E+09(cfu/yr)	2.31E+12(cfu/yr)	Implicit
Mossy Creek	E-Coli	1.59E+13(cfu/yr)	1.74E+09(cfu/yr)	1.59E+13(cfu/yr)	Implicit
Mossy Creek	Sediment	5,608(tons/yr)	0.04(tons/yr)	5112(tons/yr)	568(tons/yr)

The United States Fish and Wildlife Service has been provided with copies of these TMDLs.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a primary contact (bacteriological) and aquatic life use impairment TMDLs for Long Glade Run and Mossy Creek. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality criteria and designated uses in Long Glade Run and Mossy Creek. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a thirty-day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-

[7]Ibid 3

[8]Ibid 3

day period, most of the samples were measured against the instantaneous standard.

The Commonwealth changed its bacteriological criteria as indicated above. The new criteria require the fecal coliform concentration not exceed a geometric mean of 200 cfu/100ml of water for two or more samples collected over a month nor shall more than 10 percent of the total samples exceed 400 cfu/100ml of water. The new e-coli criteria requires a geometric mean of 126 cfu/100ml of water with no sample exceeding 235 cfu/100ml.

The HSPF model was used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from direct deposit sources. Once the existing load was determined, allocations were assigned to each source category to develop a loading pattern that would allow Long Glade Run and Mossy Creek to support the e-coli water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of e-coli to these streams will ensure that the criterion is attained.

The TMDL modelers determined the fecal coliform production rates within the watersheds. Data used in the model was obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, animal access to the stream, wildlife populations, wildlife fecal production rates, landuses, weather, stream geometry, etc.. The model combined all of the data to determine the hydrology and water quality of the streams.

The lands within the watersheds were categorized into specific landuses. The landuses had specific loading rates and characteristics that were defined by the modelers. Therefore, the loading rates were different in lands defined as forested versus pasture. Pasture lands support cattle and were influenced differently by stormwater runoff. The amount of cattle on the land, the time cattle spent on the land, and how much waste the cattle generated impacted the loading rate.

The Long Glade Run and Mossy Creek TMDL models were run using weather data collected from the Dale Enterprise, Lynchburg Airport, and Elkins Airport weather stations. This data was used to determine the precipitation rates in the watershed which transports the on land pollutants to the streams through overland and groundwater flows. Waste that was deposited to the land were subjected to a die-off rate. The longer fecal coliform stayed on the ground the greater the die-off. Materials that were washed off the surface shortly after deposition were subjected to less die-off.

Stream flow data was available for both waters. Therefore, simulated stream flow of the model could be compared directly to observed flow data. The data periods in each watershed were small and a severe drought impacted much of the Long Glade Run data. Mossy Creek was not as impacted by the drought since it is fed by four springs. The Mossy Creek model was calibrated to observed flow data from September 1998 to December 1999. During the calibration period, the model parameters were adjusted until the simulated data accurately reflected the observed flow data. The model was validated against flow data from January 2000 to September 2002. During validation, the model parameters were held constant to insure that the model was accurately reflecting stream processes. As mentioned above Long Glade Run did not have as much useable data. Therefore, the model was not validated against a separate data

set. The model for Long Glade was calibrated to flow data from September of 1999 to July 2000.

After developing the hydrology models, loading parameters were developed for each model to determine the water quality of the streams. The water quality model for Mossy Creek was calibrated to observed data from 1998 to 2002. The Long Glade Run model was developed for the same data period as its hydrology model. Both models removed the impacts from cattle in-stream when the flow was below three inches and one inch respectively. The TMDL modelers next adjusted the loading rates from the various landuses and direct deposit sources to determine what reductions were required to meet the applicable water quality criteria. Since the model accurately reflected observed data, it was able to predict the water quality as landuses and loadings in the watershed changed.

The biological assessments on Mossy Creek were not able to discern a clear stressor to the Creek. The TMDL modelers therefore conducted a stressor identification analysis to determine what was impacting the benthic community. Ambient water quality data was compared to numeric water quality criteria and ambient water quality data from Upper Opequon Creek. This analysis was able to rule out DO, temperature, nutrients, pH or toxics as the stressors to Mossy Creek. Sediment was seen as the stressor of concern to Mossy Creek. Sediment problems were also observed during habitat assessments of Mossy Creek. Excessive sediment loadings can destroy critical habitat areas, clog an organisms gills and respiratory ability, and lower the in-stream visibility for predators.

The GWLF model was used to determine the loading rates of sediment to the impaired and reference watersheds from all point and nonpoint sources. The TMDL modelers determined the sediment loading rates within each watershed. Data used in the model was obtained on a wide array of items, including landuses in the area, point sources in the watershed, weather, stream geometry, etc..

The GWLF model provides the ability to simulate runoff and sediment loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[9] To equate the reference watershed (Upper Opequon Creek) with the monitored watershed, the reference watershed was decreased to the size of Mossy Creek in the model. Each landuse was decreased in equal proportion, insuring that the landuse breakdown in the reference watershed remained constant. Local rainfall and temperature data were needed to simulate the hydrology, this data was obtained from a local weather station within the Mossy Creek Watershed and from the Winchester weather station for Upper Opequon Creek. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land, land slope, soil erodibility, and farming practices used in the area.[10]

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[9]Ibid 1

[10]Ibid 1

Parameters within the model account for these conditions and practices. The sediment load to Mossy Creek was reduced to match the load of the area adjusted Upper Opequon Creek.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There are four small facilities that are permitted to discharge bacteria to Long Glade Run and Mossy Creek. Three of these facilities discharge to Long Glade Run. The facility in Mossy Creek is permitted to discharge bacteria and suspended solids. All four facilities are permitted to discharge 1,000 gallons of effluent per day with a maximum bacteria concentration of 126 cfu/100ml. The facility in Mossy Creek can discharge 30 mg/l of suspended solids. The waste load allocations (WLAs) for these facilities can be determined by multiplying the flow by the permitted discharge by 365 after the appropriate unit conversions have been made. Table 2 lists the WLAs for these facilities.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - WLAs for the Long Glade Run and Mossy Creek TMDLs

Facility	Permit Number	Pollutant	Flow (gallons per day)	WLA
Single Family Unit	VAG401481	E-coli	1,000	1.74E+09(cfu/yr)
Single Family Unit	VAG401746	E-coli	1,000	1.74E+09(cfu/yr)
Single Family Unit	VAG401919	E-coli	1,000	1.74E+09(cfu/yr)
Single Family Unit	VAG401083	E-coli	1,000	1.74E+09(cfu/yr)
		Sediment		0.04(tons/yr)

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the impaired watersheds. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. HSPF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various landuses within the watershed. Tables 3a and 3b list the LAs for bacteria for Long Glade Run and Mossy Creek. The reductions needed to insure that the instantaneous criteria is attained at all times is extremely stringent. If the 10 percent violation rate required for a water to be placed on the Section 303(d) list was used as an endpoint, the reductions would be significantly less stringent.

For the sediment TMDL the GWLF model was used to ascertain the sediment loading to Mossy Creek. This model provides the monthly sediment load to the stream through the use of the universal soil loss equation (USLE). The USLE derives the sediment loading by using information on precipitation rates, best management practices, land slope, and vegetative cover. Table 3c lists the LAs for Mossy Creek.

Table 3a - LA for Bacteria (fecal coliform) for Long Glade Run

Source Category	Existing Load (cfu/yr)	Proposed Load (cfu/yr)	Percent Reduction
Livestock Direct Deposit	5.57E+13	5.57E+11	99
Wildlife Direct Deposit	2.53E+12	1.77E+12	30

Cropland	5.72E+14	2.86E+13	95
Pasture	4.87E+16	2.40E+15	95
Loafing Lot	1.14E+15	0.0	100
Residential	2.06E+14	1.44E+14	30
Forest	9.23E+13	9.23E+13	0

Table 3b - LA for Bacteria (fecal coliform) for Mossy Creek

Source Category	Existing Load (cfu/yr)	Proposed Load (cfu/yr)	Percent Reduction
Livestock Direct Deposit	1.89E+14	1.13E+13	94
Wildlife Direct Deposit	1.25E+13	1.25E+13	0

Straight Pipes	3.40E+12	0.00	100
Cropland	6.66E+14	3.33E+13	95
Pasture	5.15E+16	1.03E+15	98
Residential	2.38E+14	1.19E+13	95
Loafing Lot	8.52E+14	0.00	100
Forest	1.03E+14	1.03E+14	0

Table 3c - LA for Sediment for Mossy Creek

Source Category	Existing Load (tons/yr)	Proposed Load (tons/yr)	Percent Reduction
Cropland	17,621	2,349	86
Pasture	1,358	1,358	0
Urban	82	82	0
Forests	96	96	0
Channel Erosion	1,227	1,227	0

3) The TMDLs consider the impacts of background pollution.

The TMDLs consider the impact of background pollutants by considering the bacteria

load from background sources like wildlife and the sediment load from forests.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Long Glade Run and Mossy Creek are protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[11]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The HSPF and GWLF models for Mossy Creek were run over a multi-year period to insure that they accounted for a wide range of climatic conditions. The allocations developed in the TMDLs for Mossy Creek therefore insure that the criteria will be attained over a wide range of environmental conditions including wet and dry weather conditions. The TMDL for Long Glade Run was run for a one year period. Since the reductions needed to attain the criteria virtually remove all anthropogenic sources, it is believed that these reductions will allow for the attainment of criteria during most conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods.

Bacteria loadings also change during the year based on crop cycles, waste application rates, and cattle access patterns. Consistent with our discussion regarding critical conditions, the TMDLs for Mossy Creek effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time. Although not run over a multi-year period, the Long Glade Run TMDL did factor in the seasonal changes in waste application rates, cattle access patterns, and crop cycles.

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[11]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the bacteria TMDLs through the use of conservative modeling assumptions in the determination of bacteria loadings and production. An explicit margin of safety of 10 percent was used for the Mossy Creek sediment TMDL.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDLs have been subject to public participation.

Two public meetings were held during the development of the TMDL. Both meetings were held in the North River Elementary School in Moscow, Virginia. The meetings were held on June 3, 2003 and March 2, 2004. The meetings were attended by 50 and 60 individuals respectively. All of the meetings were announced in the Virginia Register and opened to a thirty-day comment period. No written comments were received in relation to the TMDL.